

MEMOIRS
OF THE
GEOLOGICAL SURVEY
OF
THE UNITED KINGDOM.

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*Figures and Descriptions*

ILLUSTRATIVE OF  
BRITISH ORGANIC REMAINS.

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DECADE V.  
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BRITISH FOSSILS.

DECADE THE FIFTH.

IN apologizing for the unavoidable delay which has taken place in the publication of this Decade, owing to the much lamented decease of Professor Edward Forbes, it is right to state that the materials left behind by him were scanty, and had been unfortunately mislaid a short time before his death. The first description only, that of *Solaster Moretonis*, had been fully written by him; of the others, we had here and there notes on the distinctive characters of the species, and of his views as to their synonymy or history. The plates, however, had been all engraved under his own eye, and the specific designations under which he wished the figures to stand, were recorded in the last edition of Morris's Catalogue. He had there also applied MS. names to a number of species to be described in the Decade.

In a few cases only it has been found necessary to alter some of these names; and this has been done in deference to an authority which would have been gladly admitted by Professor Forbes. To Mr. S. P. Woodward, of the British Museum, we are indebted for all the notes respecting these supplementary species; and he has also furnished full descriptions of three of the plates. With this valuable aid, and the friendly communications of Dr. T. Wright, of Cheltenham, we can present the Decade in nearly as complete a form as it would have possessed had our friend and Master lived to finish it. We miss, however, his lively remembrance of the living species, and his practical acquaintance with their variations,—deficiencies not to be supplied by reference to his published works.

Of the ten species figured three are new,—*Solaster Morcisonis*, *Cidaris Carteri*, and *Pygaster conoideus*. Of the other genera, *Diadema*, *Echinopsis*, and *Echinus* present us with well-known types from the Oolitic rocks, which are continental as well as British. *Pyrina* is a rare genus in England, and in this, and the two figured species of *Pygaster*, we have excellent examples of that division of the *Cassidulidae* in which the ambulacra are of uniform character throughout. Several genera of this type have been figured in the Decades. The *Pygaster semisulcatus* is a critical species, and its synonymy is now for the first time cleared up. *Hemiaster Murchisonia* is another instance of the same kind, and belongs to a large genus of closely allied species. The *Brissus Scillæ* is a Crag species still existing in the Mediterranean. None of these nine genera have before appeared in the Decades.

There are engraved plates sufficient for another fasciculus, upon which Professor Forbes left no memoranda, except the names of the species. These Plates will be published at a future period.

JOHN W. SALTER,
Palæontologist.

Geological Survey Office, Jermyn Street, London,
February 1856.

BRITISH FOSSILS.

DECADE V. PLATE II.

DIADEMA PSEUDODIADEMA.

[Genus DIADEMA. GRAY, 1835. (Sub-kingdom Radiata. Class Echinodermata. Order Echinida. Family Echinidæ.) Body circular, rather depressed; ambulacral areae with two rows of primary perforate tubercles as large, or nearly as large, as those of the interambulacra; the latter with 2 or 4 rows of primary perforate and crenulated tubercles; spines long, cylindric, striated, and annulated.]

DIAGNOSIS. *D.* 2-3 *uncialis*, *hemisphærica*, *depressa*, *tuberculis numerosis regulariter radiata*; *primariis in utrâque area binis, in ambulacro minoribus (in singula serie circa 20) in spatio altero majoribus (circa 17), secundariis parvis granulisque interpositis: disco anali parvo, rosaceo.*

SYNONYMS. *Cidarites pseudodiadema*, LAMARCK (1801), Anim. sans Vert., 1st edit. t. iii. p. 59. No. 17.; 2nd edit. 1840, vol. iii. p. 385. *Cidaris monilipora*, PHILLIPS (1829), Geol. Yorks., 1, 156. *Cidaris diadema*, YOUNG and BIRD (1822), Geol. Survey of Yorkshire, t. 6. f. 3. *Diadema Lamarckii*, DESMOULINS (1837), Tab. Synopt., p. 316. No. 18. (*sec.* Wright). *D. ambiguum*, ib., p. 316. (*sec.* Agass. and Desor). *D. pseudodiadema*, AGASSIZ (1840), Echinod. Suisses, t. ii. p. 11. tab. 17-49, 50, 52, 53. AGASSIZ and DESOR (1846), Cat. Rais. des Ech., Annales des Sc., 3rd ser. vol. vi. p. 349. WRIGHT (1851), Ann. Nat. Hist., vol. viii. p. 271. [t. 12. f. 1.] COTTEAU (1852), Etudes sur les Ech. Foss. Yonne, p. 142. pl. 17. fig. 1. [*icon mala.*]

(*Diadema hemisphæricum*, AG. Prodr. p. 22. Cot. Ech. foss. p. 139, tab. xvi. fig. 5-9 ?) *Pseudodiadema hemisphæricum*, DESOR (1855), Synopsis, p. 68.

Of this beautiful Oolitic urchin, which is not uncommon in the Coral Rag, we have had the opportunity of figuring good specimens, through the kindness of Dr. Wright and Professor Morris. It is an excellent example of the genus, which has a great vertical range. Species of *Diadema* are found in all the secondary and tertiary formations, and others are still living in the Mediterranean, and in tropical seas.

The genus, constituted by Dr. Gray for the *Cidaris diadema* of Lamarck (*Diad. turcarum*), was formerly made by Prof. Agassiz to include those similar and very elegant chalk species now known

by the name of *Cyphosoma*. None of these are yet figured in these Decades.* They differ essentially from *Diadema*, by having the tubercles imperforate, as it is called, or without a central depression; and as a character of habit may be distinguished by having the tubercles on the ambulacral area as large as those of the interambulacral, while in *Diadema* the latter are almost always of greater size. The present genus ranges through the whole of the secondary formations up to the present time; the *Cyphosoma* is confined to the chalk formations.

The numerous species of *Diadema* described by Agassiz and other authors fall, according to the Swiss naturalist, under three groups or subgenera, the characters of which are given in the "Catalogue Raisonné." In the first group, of which the living *D. europæum* is considered the type, the interambulacral areas have but two rows of primary tubercles, without secondary rows. Of this type, *D. depressum*, Ag., and *D. mamillanum*, Römer, are British fossil examples, and the majority of the species in the genus are at present arranged in it. Of the second group the species here figured is a good example. It has, besides the two primary rows of tubercles, secondary rows of less size. In the third group (*Tetragramma*), the multiplication of the larger tubercles has proceeded still farther, there being four rows at least on each interambulacral space. *D. Brongniartii*, a cretaceous fossil, is a good British species of the type.†

Description.—Diameter, 2 inches 5 lines; height, 1 inch 3 lines; diameter of the mouth (exclusive of the notches), 11 lines. General form, subhemispheric; the upper surface depressed above, the inferior surface very much flattened. From the depressed apex the sides slope a little outwards to the rounded margin, radiated pretty equally by the five lanceolate ambulacra, which are very little, if at all, more prominent than the intervening spaces. They are furnished with two rows of primary tubercles, about twenty in a row, which are small near the apex, and increase in size towards the margin, where three or four become abruptly larger; all are perforate, and on crenulated bosses. Between them, for all the lower two thirds of the ambulacrum, there is a single row of small

* A notice of some species of this genus, considered new by the late Prof. E. Forbes, will be found at the end of this Decade.

† Desor combines (in his recent work, 1855) the first and second of these groups in the section "*Pseudodiadema*," and he also separates those species which have the pores crowded above (*D. subangulare*, Agass., and *D. pentagonum*), under M'Coy's genus *Diploporidia*. (See Appendix.)

secondary tubercles, and a few granules also are interspersed. On the plates of the upper surface these granules surround the primaries, but on the lower ones are only occasionally to be met with.

The primary tubercles in the interambulacral spaces are larger than those on the ambulacra, but not quite so many in a row (about sixteen or seventeen), and from about the upper third of the segment there are secondary tubercles, likewise perforated, but very much smaller. There is a single row of these outside the primaries, and a double row down the middle. These secondary tubercles are largest at the turn of the margin, and decrease rapidly in size above or below that point. Each plate, at least on the more prominent parts of the test, bears two or three secondary tubercles on each side of the primary one. Of these the most conspicuous are placed on a line with the primary tubercle, the others occupy the angles of the plates, and are interspersed with numerous granules, which only on the upper plates surround the primary bosses. These bosses are of a transverse broad oval form, and for the greater part of each row are confluent at the base. They are flat round their base, then rise steeply to the crenulated edge, which is divided by about fifteen notches, and support small strongly perforated tubercles. They increase very regularly in size outwards, and radiate regularly from the apex, instead of divaricating widely, as in the recent *D. turcarum*, and then converge rapidly on the under surface, so as to leave a depressed space between the ambulacral tubercles occupied by the pores. There are about seventy pairs of pores in each row, which are disposed in a single series, and run in nearly a straight line from the apex to the circumference; below this they undulate a little, and close to the oral margin about twenty pairs fall into ranks of threes.

Each pair of pores forms an ovoid, and is included in a ring, and an elevated tubercle or ridge separates the pores, forming as it were a handle across the elliptical space.

The apical disk is small compared with that of other species, in our largest specimens not half an inch across. It is composed of five obovate genital plates, and five minute ocular plates; the genital plates extend outwards much beyond the oculars; they are covered by large granules, and are perforated nearer the outer than the inner margin.

The right (anterior?) plate, which bears the madreporiform tubercle, is decidedly larger than the rest. The anus is roundish, not quite regular in shape. The mouth is larger than in our figure, measuring, from point to point of the ten deep notches, at least

three fifths of the whole diameter. The notches are placed in pairs at the oral edge of the interambulacral spaces, their depth being about equal to their width apart, and those of each pair are considerably nearer to one another than to the neighbouring pair.

Our specimens shew no spines. They are, however, represented by Prof. Agassiz in the *Ech. Suisses*, t. 17. f. 51., as slender, cylindrical, solid, pointed at the ends, and finely striated.

Affinities.—There seems to be no other English species with which it can be compared, unless a somewhat more convex and smaller form which is said to occur with it in the Malton Oolite may be considered distinct. This species or variety has fewer (twelve) and rather more prominent interambulacral tubercles, and the secondaries between these are smaller and fewer. The ambulacra are a trifle narrower in proportion, and are somewhat more convex than the intervening spaces, while in the figured species there is no such difference; and as the primary tubercles are not so crowded in the rows, they are rounder and less oval than in *D. pseudodiadema*. The apical disk is very much the same, but there is a difference in the arrangement of the pores near the mouth, which can scarcely be due to age—only about eleven or twelve pairs of pores (instead of twenty) being formed into ranks of threes. Specimens of this in the British Museum and the Geological Survey Collections agree with *D. hemisphaericum*, Ag., as figured by Cotteau, and are in all probability French specimens from the Coral Rag.

On this species Prof. E. Forbes left a good many notes, which are embodied in the above description, and his views of the synonymy are correctly expressed here, as also in the second edition of Morris's Catalogue. He has quoted in his MSS. the reference to *D. Lamarckii* of Desmoulins (which Dr. Wright adopts) with a doubt, and remarks of Cotteau's figure, "that it represents a cast, and is not good in its details. The pores are especially confused. Unaccountably, too, perhaps by the erroneous drawing of the pores in Phillips's figure, Cotteau has referred *Echinus germinans* of Phillips (*E. perlatus* of this Decade) to his species." Agassiz and Desor, in the *Cat. Rais.*, have done the same, though with a mark of doubt. The *D. ambiguum* of Desmoulins, according to these authors, is a synonym of the present species.

Locality and Geological Position.—CORAL RAG. Malton, near Scarborough.

Foreign Localities and Range.—"CORALLIEN" of Besançon, canton de Soleure; St. Mihiel; La Rochelle.

J. W. SALTER.

January 1856.

DESCRIPTION OF THE PLATE.

Fig. 1. *Diadema pseudodiadema*, Lam., from Dr. Wright's specimen; the apical plates are restored from one lent by Prof. Morris.

Fig. 2. Side view of do.

Fig. 3. Part of the under surface, showing the deeply incised angles of the mouth and the pores, a few only near to the mouth, in ranks of threes.

Fig. 4. Portion of an ambulacral and of an interambulacral segment magnified; the pores in simple pairs, with a tubercle between each pair.

Fig. 5. Part of an ambulacral segment near the mouth, shewing the pores in ranks of threes, magnified.

Fig. 6. Apical disk, with 5 minute ocular plates, and 5 large and nearly equal ovarian plates; the right anterior one a little the largest, and bearing the madreporic tubercle.

Other British Species of Diadema.

In the second edition of Morris's Catalogue of British Fossils, Prof. Forbes had materially increased the list of the British species of this genus. Of the new species there recorded and referred to as described in this Decade, characters will be given, so far as the materials permit, by our friend Mr. Woodward. In the arrangement of the species he follows Desor, except that he regards his groups as subgeneric only.

Notes on British Fossil Diademas. By S. P. Woodward, Esq.

* JURASSIC SPECIES.

Section A. (*Pseudodiadema*, Desor.) Pores in single file.

1. *D. pseudodiadema*, Lam. Above described.

2. *D. Moorei*, Wright, Ann. Nat. Hist., 1854., pl. 12. f. 3.

Localities.—UPPER LIAS, Ilminster; also in Normandy.

3. *D. æquale*, Ag., Ech. Suis., t. 17. f. 36–38.

Locality.—"CORAL RAG, Steeple Ashton; McCoy." Morris's Cat. 76. The original specimen, in the Cambridge Museum, is a fragment of *D. versipora* (*Diplopodia*); another, in the Brit. Museum, appears to be the real *D. æquale*, but its locality is not certain.

4. *D. depressum*, Ag., Cat. 8. Wright, Ann. Nat. Hist. 1851, vol. viii. t. 12. f. 2.

Localities.—BRADFORD CLAY, Cirencester. GREAT OOLITE, Minchinhampton. INFERIOR OOLITE, Crickley Hill and Dundry.

4 a. *D. armatum*, Forbes, MS. Morris's Cat., 76.

Locality.—INFERIOR OOLITE, Castle Carey, (not Gloucestershire), Somerset.

Represented in the Museum of Practical Geology by four small and imperfect specimens, undistinguishable from small examples of *D. depressum*.

5. *D. mamillanum*, Rømer, Ool., vol. i. p. 26. t. 2. f. 1. *D. Davidsoni*, Wright (1854). Ann. Nat. Hist. vol. xiii. pl. 12. f. 2.

Localities.—CORAL RAG, Calne (Brit. Mus.); Redcliff, near Weymouth (Geol. Survey.)

The British specimens agree perfectly with specimens received from Dr. Rømer, labelled "U. Coral Rag, Hildesheim, Hanover."

6. *Diadema homostigma*, Ag. (sec. Desor), Ech. Suiss. ii. p. 24, t. 17, f. 1-5.

Locality.—CORNBRAsh, Stanton, &c., Wilts (W. Buy).

7. *D. vagans*, Phil. sp., Geol. Yorks., t. 7. f. 1.

Locality.—CORNBRAsh, Yorkshire. (Morris's Cat. p. 77).

[The *Cidarites Bechei*, Brod. in Geol. Proc. vol. ii. p. 202 (not Geol. Tr. 2. ser. 2. t. 4. f. 5.), from the LIAS of Lyme Regis, was considered a *Diadema* by Prof. Forbes. The original specimen is in the Mus. Geol. Soc. From the condition of the specimen it would be quite indeterminable, but comparison with better examples developed by Dr. Wright shows it to be an *Echinopsis*.]

8. *D. Bakeriæ*, Woodw.

Body sub-pentagonal, depressed; lat. 16, alt. 7 lines; diameter of buccal opening 7 lines, anal 4 lines; primary tubercles prominent, in 2 rows of about 13 each, on all the areas; bosses crenulated; interspaces sparingly granulated, becoming bare above; pores in single file.

Locality.—CORNBRAsh, Caistor, Northamptonshire. Collected by Miss Baker. (Coll. Brit. Mus.)

[The *Diadema minimum*, Ag., of Morris's Catalogue (*Diadema minuta*, Buckman), is an *Acrosalenia*, and was first described by Quenstedt under the name of *Cidarites criniferus*.]

9. *D. "subangulare"*, Ag., Ech. Suisses, iv. 19. t. 17. f. 21, 22. (not of Goldfuss). *Cidarites versipora*. Woodw. MS. Morris's Cat. 1st edit. p. 50. Bronn, Index, p. 301.

Localities.—CORAL RAG, Calne and Hillmarton, Wilts; Farrington, Berks.

There are two varieties of this species; one with the upper surface evenly inclined all round, the other tumid at the angles and depressed in the centre above. The spines are like those of *D. pseudodiadema*. The figure given by Agassiz agrees with a Swiss specimen in the Brit. Mus., and differs from the British examples in having fewer and more prominent primary tubercles, especially on the ambulacral areas, (viz. 11 instead of 13 to 16 in each row), and the ambulacral rows are not so widely separated by a finely granulated space.

We cannot agree with M. Agassiz in considering either of these forms referable to the "*Cidarites subangularis*" of Goldfuss (Petr. 1. 122. t. 40. f. 8.) German specimens, agreeing with Goldfuss's figure and description in the presence of only a single series of pores, are in the British Museum.

Section B. (*Diplopodia*, M'Coy), Pores crowded above and below.

10. *D. pentagonum* (*Diplopodia*), M'Coy, 1848, Ann. Nat. Hist. p. 412.

Locality.—GREAT OOLITE, Minchinhampton. (Woodw. Mus., Brit. Mus., &c.)

In this little species the pores are crowded at the ends of the ambulacra, as in *D. "subangulare"*; the character has not been considered of generic importance by M. Agassiz or Prof. Forbes, either here or in the cretaceous and recent species, but it has been adopted by M. Desor.

* * CRETACEOUS SPECIES.

Section A. Primary tubercles in two rows; pores in single file. (*Pseudodiadema*.)

11. *D. ornatum*, *Cidarites*, Goldfuss, Petr. t. 40. f. 10. (Forbes, in Mus. Pract. Geol. and Morris's Cat. 2nd edit.) *Cyphosoma Milleri*, part, Forbes, in Dixon, Geol. Sussex, pp. x. and 340, pl. 25, f. 17. (Mus. Bowerbank.)

In the first edition of Morris's Catalogue this name was introduced, at my suggestion, for the Warminster fossil, afterwards considered distinct and named *D. Benettii*.

Prof. Forbes, however, still referred to Goldfuss's species a specimen from the Grey Chalk of Dover, presented to the Museum of Economic Geology, by E. H. Bunbury, Esq., M.P.

This specimen is circular, and measures 14 lines in diameter, by $6\frac{1}{2}$ in height; the upper opening is pentangular, and 6 lines across; the mouth only 4 lines, and very deeply sunk; the primary tubercles are more prominent than in *D. Benettia*, diminishing in size below, but not much upwards; the areolæ are radiated; the interambulacral tubercles are 12 in each row, divided by two rows of irregular granules, separating above and leaving bare channels; these areas are bordered below by two rows of accessory tubercles; the ambulacral tubercles are like the others, in two rows of 12 each, and nearly as large, converging above; the pores are close together above, but towards the circumference they are separated by conspicuous tubercles, or groups of granules, which gives them a straggling appearance, and makes them difficult of detection.

A second example of this *Diadema*, presented to the British Museum by Daniel Sharpe, Esq., has 14 tubercles in each row, and Mr. Bowerbank's example, referred to above, has 16-17 primary tubercles, which are consequently smaller and more crowded. A specimen in Mr. Mackie's cabinet is more elevated, and remarkably contracted at the base: it measures $13\frac{1}{2}$ lines in diameter, and $7\frac{1}{2}$ in height.

Locality.—CHALK MARL, DOVER. (Mus. P. Geol., Brit. Mus. &c.)

12. *D. Benettia*, Forbes, Morris's Catalogue, 2nd edit. 1854. (*Cidarites ornatus*, Goldf., Petr., t. 40. f. 10.?) Desor, Synopsis, p. 12.

Body circular, inflated, depressed; lat. 14, alt. 6 lines (sp. maj.); apical disk large ($15\frac{1}{2}$ lines diam.), pentagonal; oral opening small (4 lines), deeply sunk; ambulacral tubercles as large as the interambulacral, in two distinct rows of about 15 each, separated by a double row of minute tubercles and granules; interambulacral tubercles in two primary rows of about 14 each, separated by a wide median space, unequally granulated, which becomes smooth above, and bordered by similar spaces, in which a few small tubercles are developed. The areolæ are sometimes radiated. Pores in regular distinct rows; those of the circumference with a small tubercle between each pair.

This species, abundant in the Upper Green Sand of Warminster, was dedicated by Prof. Forbes to the late Miss Etheldreda Benett, of Norton House, authoress of the "Catalogue of Wiltshire Fossils" (1831). In the first edition of Morris's Catalogue it was recorded as *D. ornatum*, Goldf., at my suggestion; and in the second edition, both names appear for the one species. As we have no authentic examples of *D. ornatum*, it is impossible to say in what respect it differs. M. Michelin has, however, communicated to Dr. Wright a specimen labelled "*D. ornatum*, Goldf.—Cap la Hève," which is undistinguishable from the Warminster specimens of *D. Benettia*.

Localities.—UPPER GREEN SAND, Warminster; Durdle Cove, Dorset.

13. *D. Barretti*, Woodw.

Circular, depressed; lat. 11, alt. 5 lines; pairs of pores in single file throughout; ambulacral tubercles as large as interambulacral, in 2 distinct rows of 12 each, divided by a double row of granules margining the plates; interambulacral tubercles in 2 principal rows of 11-12 each, separated by 4 rows of granules, which partly surround the tubercles of the circumference and 2 secondary rows of 8-9 rather smaller tubercles; base concave; apical opening moderate, pentangular.

Differs from "*D. Benettia*," Forbes, and from *D. tenue*, Ag., in the development of secondary rows of interambulacral tubercles.

Locality.—UPPER GREEN SAND, Cambridge. (Coll. Brit. Mus., and of Jas. Carter, Esq.)

14. *D. Bonei*, Forbes, Morris's Catal., 2nd edit. 1854.

Circular or slightly pentagonal, depressed; lat. 9, alt. 4 lines; base rather flat; ambulacral tubercles rather prominent, as large as the interambulacral, in 2 rows of about 10 each, close together, separated only by a zigzag line of small granules; interambulacral tubercles also in 2 rows of 10 each, with accessory rows of about 6 small tubercles outside. This urchin agrees with a specimen from M. Michelin, labelled (erroneously) "*D. subnudum*, Villers sur Mer;" it is perhaps the *D. Michelini*, Desor, Synopsis, p. 72.

Locality.—This species is rather less abundant than *D. Bennettie* in the UPPER GREEN SAND of Warminster, and never attains an equal size. It has a more spinose appearance, owing to the closer approximation of the ambulacral tubercles.

Note.—*D. rotatum*, Forbes, l. c., is the *Cyphosoma difficile*, Ag., and *D. M'Coyi*, Forbes, (*D. rotulare*, M'Coy, not Ag.), does not differ from it in any respect.*

15. *D. Rhodani*, Ag., Ech. Suisses, t. 16. f. 16–18.

Locality.—"UPPER GREEN SAND, Blackdown, M'Coy," (Morris's Catal. p. 77.) The locality requires confirmation.

16. *D. Desori*, Forbes. (Syn. *D. Rhodani*, Ag.?)

Circular, depressed, convex above, concave beneath; lat. 10, alt. $4\frac{1}{2}$ lines; apical disk small (lat. $3\frac{1}{2}$ lines), pentagonal; ambulacra sinuous; tubercles in two rows of 10 or 11 each in all the divisions, those of the upper surface (3 of each row) minute, with very small bosses and areolæ, the interspaces minutely and uniformly granulated; marginal tubercles 2 or 3 in each row, large and prominent; base with accessory rows of tubercles on each side, and in the centre of each division; the whole small, subequal, and closely ranged.

The solitary specimen in the Museum of the Geological Survey, upon which this species was founded, was at first identified with *D. Rhodani*, Ag., but afterwards, probably with the approval of M. Desor himself, considered distinct. Compared with Agassiz's figure, and with an authentic example of *D. Rhodani* in the Brit. Museum, it differs in the size and form of the apical opening, and in the larger number of small tubercles on the upper aspect, thus giving a greater extent of uniformly granulated surface. Several other specimens in the collections of Mr. Cunnington and Mr. Sloper of Devizes have been examined, and show that the species is liable to considerable variation.

Locality.—UPPER GREEN SAND, Warminster.

17. *D. pustulatum*, Forbes, l. c.

Sub-pentagonal, depressed, concave beneath, convex above, slightly inflated at the angles; lat. 14, alt. 6 lines; ambulacral tubercles in 2 distinct rows of 14 or 15 each, with 3 rows of small accessory tubercles (5 or 6 in each) below; interambulacral tubercles 13 or 14 in each row, with 6 accessory rows of small unequal tubercles beneath; tubercles largest at the circumference, becoming gradually smaller above and below; areolæ of the upper tubercles very small, interspaces uniformly granulated.

This species resembles M. Agassiz's figure of *D. Rhodani* even more than the last; compared with the specimen from the Perte du Rhone, it differs in the greater number and regularity of the rows of tubercles, the wider space between the ambulacral rows, the more densely granulated interspaces, and the greater number of accessory tubercles beneath. It is to be feared that the discovery of more specimens will not increase the validity of these differences.

Locality.—UPPER GREEN SAND. (Craie chloritée), Chardstock. Presented to the Mus. Pract. Geology by E. H. Bunbury, Esq., M.P.

* It has been placed in the genus *Glypocyphus* by M. Desor (Syn. p. 104), from which it differs totally in the character of its apical disk.

18. *D. tumidum*, Forbes, l. c.

Circular, inflated; lat. 9, alt. 5 lines; ambulacra straight; tubercles numerous, small, subequal, those of each division in 2 distinct rows; areolæ small, slightly radiated; ambulacral tubercles separated by a double row of granules; interambulacra bordered by a few very small accessory tubercles; interspaces granulated, becoming quite bare near the apical opening. (Spines slender, solid, smooth. *Coll. Bowerbank.*)

Locality.—CHALK MARL of Dover. Chlor. marl. Somerset. (Coll. Wright; Tennant.)

The original specimen was presented to the Museum of the Geol. Survey by Edwd.

Clarke, Esq., and stated to be from the GAULT of Folkestone. It is partly incrustated with pyrites, and filled with a matrix of what appears to be GREY CHALK. A better example of the same species in the Brit. Museum, undoubtedly from the Grey Chalk of Dover, has 12 or 13 tubercles in each row.

19. *D. Carteri*, Woodw.

Circular, tumid; lat. 10, alt. 6 lines; pairs of pores in single file; *ambulacral* tubercles as large as the interambulacral at the circumference, becoming much smaller above and below, in 2 close rows of 11 each, alternating; *interambulacral* tubercles 12 in a row, separated by a moderately wide granulated space, and flanked by rows of about 6 secondary tubercles externally, on the under side. *Base* concave; apical opening small.

Closely related to *D. tumidum*, Forbes. The ambulacral bosses are closer together, and the secondary rows of interambulacral tubercles more developed.

Locality.—UPPER GREEN SAND, Cambridge. (Coll. L. Barrett, and of Jas. Carter, Esqrs.)

Section B. Primary interambulacral tubercles in 4 rows; pores in double series at the summit. (*Tetragramma*, Agassiz.)

20. *D. variolare*, Alex. Brongniart, 1834, Env. Par. p. 152. pl. M. f. 9. (*sec.* Forbes.)
Syn. *Cyphosoma Milleri*, Forbes, in Dixon, Geol. Sussex, pl. 25. f. 17. (Mus. Bowerbank.)

Localities.—Specimens agreeing pretty well with M. Agassiz's published *cast* occur in the CHALK MARL of Dover (Brit. Mus. and Mus. Pract. Geol.), but it is impossible to ascertain what species was intended by M. Brongniart's figure and description, without reference to the original specimen.

It is rather singular that in Morris's Catalogue (p. 77.), we are referred for a representation of this species to Agassiz's figure of *D. Brongniarti*, whilst Bronn (Index, p. 1261.) and D'Orbigny (Prodrome, 2, p. 142.) quote Brongniart's figure of *D. variolare* in illustration of Agassiz's *D. Brongniarti*. Bronn also quotes Goldfuss's *Cidarites variolaris*, which is a *Cyphosoma*, and D'Orbigny places both species in the *Gault*.

21. *D. Brongniarti*, Ag., Ech. Suiss., t. 14. f. 4—6.

Localities.—GREY CHALK, Dover (Brit. Mus.). Chloritic Marl, Maiden Bradley, Somerset (Geol. Survey). These specimens have been compared with typical examples from the Upper Green Sand of the Perte du Rhône. In the recently published Synopsis of M. Desor, this species is accidentally placed in the genus "*Pseudodiadema*," amongst the species with pores in single file, whilst *D. variolare* is placed in the genus *Diploporidia*.

22. *D. Mackiei*, n. sp.

Inflated, depressed; lat. 24 lines; oral opening deeply sunk, lat. 6 lines; apical opening pentagonal, $7\frac{1}{2}$ lines; ambulacral pores crowded above; primary tubercles not diminishing sensibly above, but decreasing regularly below; ambulacral tubercles in two rows of 17 each, *at wide intervals above*, the rows separated by a continuous granulated space; interambulacral tubercles in 6 *principal rows*, bordered at the circumference by accessory

rows, the central space wide, granulated, and tuberculated, becoming bare and channelled above; spines slender (less than a line wide), solid, finely striated. A still larger specimen, in M. Bowerbank's cabinet, measures $2\frac{1}{2}$ inches across.

Locality.—GREY CHALK, Dover. (Coll. S. J. Mackie, Esq., and Bowerbank.)

23. *D. subnudum*, Ag., Cat. Echin., p. 46. (Forbes.)

Sub-pentangular, depressed; lat. $10\frac{1}{2}$, alt. 4 lines; base flat; apical opening pentangular, its diameter 4 lines; ambulacra straight, widening and confluent above; the pairs of pores in a compact double series as far as the fourteenth, a few next the mouth arranged in threes; primary tubercles small, subequal, those of the ambulacra in 2 close rows of 15 or 16 each, diminishing gradually from the circumference, and becoming very minute upwards; interambulacral tubercles in 2 principal rows of 11 or 12 each, diverging upwards, surrounded by rows of granules below, and divided by a bare space above; outer rows shorter, of 6 or 7 tubercles each.

Locality.—This species, which closely resembles the Oolitic *D. subangulare*, Ag., is one of the less common forms met with in the UPPER GREEN SAND of Warminster; there are two specimens in the collection of Dr. Wm. Smith (Brit. Mus.), and several in the Museum of the Geol. Survey. It is more abundant, and attains a larger size in the chloritic marl of Somersetshire; specimens in Dr. Wright's collection measure 13 lines in diameter, and have 6 rows of interambulacral tubercles, nearly equal in size at the circumference, like *Diplopodia Roissyi*, Desor. In the collection of Dr. Wright is a specimen of this urchin from the U. Green Sand of France, labelled "*D. variolare*, Br.," by M. Michelin.

23 a. *D. dubium*, Albin Gras, Oursins Foss. Suppl., p. 3. f. 21—23. (Forbes.)

The specimens from Farringdon agree in their general character with a cast of the typical *D. dubium*, in Dr. Wright's cabinet, and may be identified with *D. subnudum*, Ag., to which species M. Desor unites the *D. dubium*, but their state of preservation does not admit of very exact comparison.

Locality.—LOWER GREEN SAND of Farringdon, Berks. (Brit. Mus.)

24. *D. Mackesoni*, Forbes, l. c.

Sub-pentagonal, depressed, inflated at the angles; lat. 18, alt. 7 lines; apical opening pentagonal, lat 7 lines; ambulacra straight and rather wide, scarcely meeting above; pores obliquely two-ranked as far as the fourteenth pair; ambulacral tubercles divided by 2 rows of granules, and not diminishing much upwards; interambulacral tubercles in 4 rows, the principal rows parallel, the outer rows shorter by 3 tubercles above.

Locality.—From the LOWER GREEN SAND (Kentish rag) of Hythe, presented to the Museum of the Geol. Survey by Mr. H. B. Mackeson, Copt Pt. Folkestone. (Coll. Mackie). It is nearly related to *D. subnudum*, with which, as the better preserved species, it has been compared.

25. *D. Ibbetsoni*, Forbes, Morris's Cat., p. 76.

Circular, depressed, lat. 9, alt. $3\frac{1}{2}$ lines; apical opening 3, oral $3\frac{1}{2}$ lines across; base tumid; primary tubercles rather large and close-ranked, ambulacral 11–12, the 3 uppermost minute; interambulacral tubercles in two principal rows of 11 and 12 each, and two external rows, shorter by 3 or 4 tubercles above, and diminishing rapidly beneath; pores obliquely two-ranked above, as far as the ninth pair, and again near the mouth.

This species attains a larger size, but the examples hitherto obtained are fragmentary and obscure; the small specimen described is very distinct from Dr. Wright's *D. Autissiodorensis*, which has only two rows of interambulacral tubercles, and wide miliary zones. It is more like *D. Mackesoni*, but is more closely tuberculated above.

Locality.—LOWER GREEN SAND, Atherfield, Isle of Wight. (Mus. Geol. Soc.)

26. *D. Autissiodorensis*, COTTEAU, Cat. Méth. (1851), p. 5. *see* Wright, Ann. and Mag. Nat. H. (1852), vol. x. p. 91.

Locality.—LOWER GREEN SAND, "Cracker-rock," Atherfield, Isle of Wight. (Coll. Wright.)

Section C. Spines tubular, annulated. (*Diadema*.)

27. *Diadema*, sp.

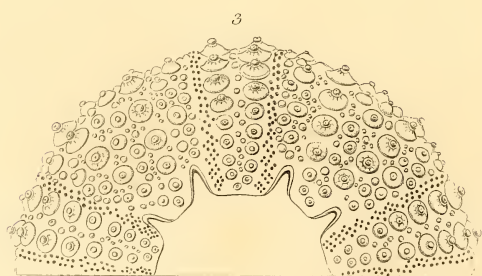
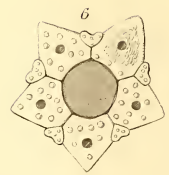
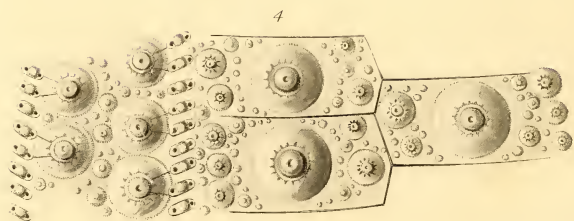
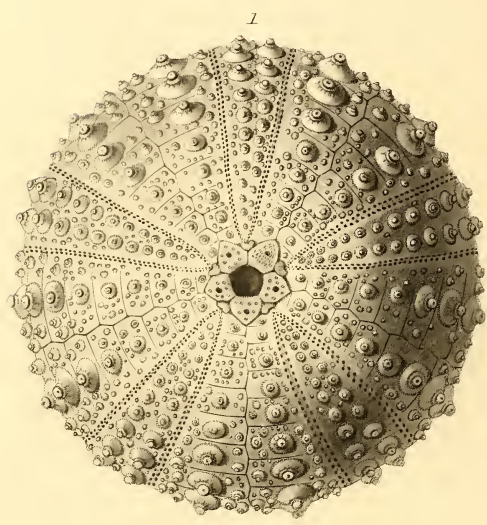
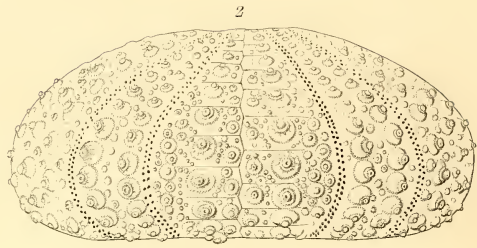
This specimen consists of numerous scattered plates, with portions of the dental apparatus, and fragments of above 100 spines. Nearly all the plates exhibit only the smooth internal surface; the ambulacral pores are in single file, becoming a little crowded near the oral extremity; the interambulacral tubercles appear to have formed more than two rows, and are of unequal size; they are distinctly perforated and crenulated. The spines are *tubular*, longitudinally striated and annulated (as, *e. g.*, in the recent *D. calamaria*); the annulations are often oblique, and that nearest the articular end is very prominent. These spines are cylindrical and slender; the largest fragment measures 15 lines, with a diameter of half a line, and may have been 3 inches long when perfect.

Attention has been directed to this specimen by Mr. L. Barrett, F.G.S., who ascertained that a spine from it had been inadvertently figured in pl. 10, f. 15, of Decade 3. The figure is very bad, and the oblique annulations are described as *spirals* (*Micraster*, Decade 3, p. 4). Several specimens, precisely similar, are in the cabinet of Mr. Bowerbank, one of them has been figured in Dixon's Geol. Sussex, pl. 25, f. 8, as the spine of a *Cidaris*.

Locality.—UPPER CHALK, Kent. (N. T. Wetherell, Esq.)

S. P. WOODWARD.

March 1856.



DIADEMA PSEUDO-DIADEMA — *Lamarck*.